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Recent Performance of and Plasma Outage Studies with the SNS H- Ion Source

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Early in 2014, after several years of producing neutrons with ~1 MW proton beams, SNS started to ramp to higher power levels that can be sustained with high availability. Powers of up to 1.4 MW may be possible despite a compromised RFQ, which requires higher RF power than design levels to approach the nominal beam transmission. Unfortunately at higher power the RFQ often loses its thermal stability, a problem apparently enhanced by beam losses and high influxes of hydrogen. This led to the semi-retirement of the high-performing source #3. The apparently lower beam losses of the other two sources shifted the goal to delivering as much H- beam as possible with the least amount of hydrogen in the source, which led to plasma outages. Ongoing plasma outage studies show that the 13 MHz supply struggles with the ~90% power reflected by the 1-ms long 2-MHz plasma pulses. Possible mitigations are being tested, starting with a 4-ms RC filter for the reflected power signal.

Lowering the H2 pressure initially increases the H- beam current due to reduced losses, and since mid-2014 ~50 mA are routinely injected into the RFQ. Subsequent LEBT retuning improves the RFQ transmission by better matching the reduced-divergence beams. Accordingly ~35 mA H- beams exiting the RFQ have become routine.

To further support higher powers, under-performing sources are replaced after two weeks while well- performing sources are used for up to 8 weeks, frequently exceeding 3 A□h of H- without showing signs of aging.

These new approaches increased the average RFQ output peak current at the end of the pulse by ~2 mA while the standard deviation was reduced from 1.9 to 1.3 mA compared to the prior year, which included the high performing source #3.